LUNAR CRUSTAL HISTORY FROM ISOTOPIC STUDIES OF LUNAR ANORTHOSITES. L. E. Nyquist[1], C.-Y. Shih[2], D. D. Bogard[1], A. Yamaguchi[3]. [1]KR/NASA Johnson Space Center, Houston, TX 77058. E-mail: laurence.e.nyquist @nasa.gov. [2]ESCG Jacobs-Sverdrup, Houston, TX 77058. [3]National Institute of Polar Research, Tachikawa, Tokyo, 190-8518, Japan.

Anorthosites occur ubiquitously within the lunar crust at depths of ~3-30 km in apparent confirmation of the Lunar Magma Ocean (LMO) hypothesis. [1]. We will present recent chronological studies of anorthosites [2] that are relevant both to the LMO hypothesis and also to the lunar cataclysm hypothesis.

Old (~4.4 Ga) Sm-Nd ages have been determined for some Apollo 16 anorthosites, and primitive initial $^{87}Sr/^{86}Sr$ ratios have been measured for several, but well-defined Rb-Sr ages concordant with the Sm-Nd ages have not been determined until now. Lunar anorthosite 67075, a Feldspathic Fragmental Breccia (FFB) collected near the rim of North Ray Crater, has concordant Sm-Nd and Rb-Sr ages of 4.47±0.07 Ga and 4.49±0.07 Ga, respectively.

Initial $^{143}Nd/^{144}Nd$ determined from the Sm-Nd isochron corresponds to $\varepsilon_{Nd,CHUR} = 0.3\pm0.5$ compared to a Chondritic Uniform Reservoir, or $\varepsilon_{Nd,HEDPB} = -0.6\pm0.5$ compared to the initial $^{143}Nd/^{144}Nd$ of the HED Parent Body [3]. Lunar anorthosites tend to have $\varepsilon_{Nd} > 0$ when compared to CHUR, apparently inconsistent with derivation from a single lunar magma ocean. Although $\varepsilon_{Nd} < 0$ for some anorthosites, if lunar initial $^{143}Nd/^{144}Nd$ is taken equal to HEDR for the HED parent body [3], enough variability remains among the anorthosite data alone to suggest that lunar anorthosites do not derive from a single source, i.e., they are not all products of the LMO.

An anorthositic clast from desert meteorite Dhofar 908 has an ^{39}Ar-^{40}Ar age of 4.42±0.04 Ga, the same as the 4.36-4.41±0.035 Ga ^{39}Ar-^{40}Ar age of anorthositic clast Y-86032,116 in Antarctic meteorite Yamato-86032 [3,4].

Conclusions: *(i) Lunar anorthosites come from diverse sources.* Orbital geochemical studies confirm variability in lunar crustal composition [1, 5]. We suggest that the variability extends to anorthosites alone as shown by the Sm-Nd data (Fig. 2) and the existence of magnesian anorthosites (MAN, [6]) and "An93 anorthosites" [3,4]. (ii) *Anorthositic clasts in lunar meteorites retain "high" Ar-Ar ages compared to Apollo anorthosites.* This is perhaps a hint that "cataclysmic" impacts were on average less energetic in the mostly farside source regions of these meteorites than on the lunar nearside.

References: [1] Ohtake M. et al. (2009) *Nature 461,* 236-241. [2] Nyquist L. et al. (2009) *LPSC41,* submitted. [3] Nyquist L. et al. (2006) *GCA 70,* 5990-6015. [4] Yamaguchi A. et al (2010), *GCA,* submitted. [5] Cahill J. T. S. et al. (2009) *JGR 114,* E09001. [6] Takeda H. et al. (2006) *Earth Planet. Sci. Let. 247,* 171-184.